Appendix B

Stream Survey of Mineral Creek

Final Report to

U.S. Forest Service, Gila National Forest

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Introduction

Following telephone discussions with Bruce Anderson, wildlife biologist for the Gila National Forest, it became obvious that Mineral Creek should be evaluated as a potential Gila trout restoration stream for consideration by the Gila Trout Recovery Team. A preliminary survey of Mineral Creek was made June 22-24, by Department of Fishery of Wildlife Sciences graduate students Kim Mello and Richard Anderson and undergraduate Randy Risinger. This initial survey was made in anticipation of funding of a research proposal already submitted to the U. S. Fish and Wildlife Service. During the June 22-24, 1976 survey, Stations 1, 2, 4, and 6 were sampled (Figure 1). The only fish species collected in Mineral Creek was rainbow trout, Salmo gairdneri.

The section of Mineral Creek from the end of Forest Service Road 701 upstream about 2 miles to the mouth of Red Canyon was walked the afternoon of August 21, 1976 by the following persons: Paul Turner; Dr. John Rinne, Rocky Mountain Forest and Range Experiment Station; and Dr. Jim Johnson, Endangered Species Specialist of the U.S. Fish and Wildlife Service. General observations of the habitat were made and limited water quality data taken.

After further discussions with Bruce Anderson and Ray Swigart, U.S. Forest Service, Gila National Forest agreed to fund a followup survey of Mineral Creek. Funding for this survey was by purchase order to Paul Turner in order to pay survey expenses. The second survey was made September 4-6 with Richard Anderson as survey leader. A second 200 foot section adjoining stations 2, 4, and 6 was evaluated for physical, biological, and water quality parameters, but were not electrofished again. Three additional stations (3, 5, and 7) were evaluated during the second survey. In addition, riparian condition transects were made at Stations 2, 3, 4, 6, and 7 (Figure 1).

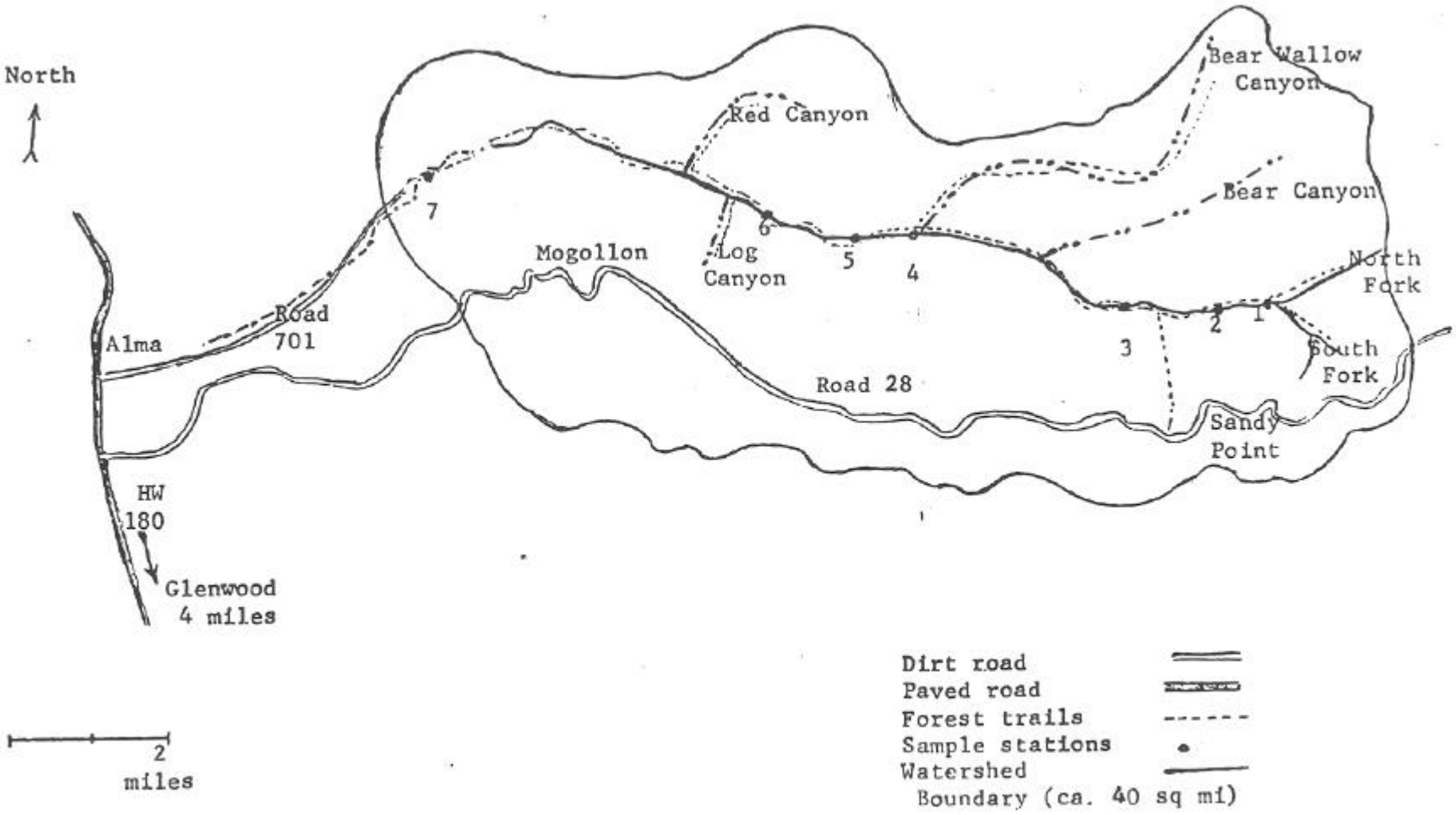

Figure 1. Location of Mineral Creek and sampling stations

Methods

Seven sampling stations were selected to describe the variation in habitat from the headwater area (Station 1) to near the elevation 7760 ft., M.S.L. lower end of the stream which presently supports trout (Station 7), 5560 ft., M.S.L. A short description of the location of each sampling station is given in Appendix A and in the station narratives. The location of each station is indicated on the attached topographic map. Physical, water quality, and biological parameters described in the U.S. Forest Service's "Stream Habitat Evaluation Technique" were evaluated at each sample station.

Physical habitat parameters evaluated were pool-riffle ratio, stream bottom type, streamside vegetation and bank stability, pool depth, mean stream width and flow rate (Table 1). Turbidity, total alkalinity, total dissolved solids (conductance), sulfates, and heavy metals concentrations were determined by Rhea Soloman, hydrologist (Gila National Forest) from a water sample taken July 30, 1975 400 meters downstream from Station 7 (Table 2). Results of the chemical analysis of a water sample collected June 24, 1976 were not available at the time this report was written. Additional water samples were collected by Dr. John Rinne for chemical analysis. The upstream sample was collected from Mineral Creek 100 feet upstream from the mouth of Red Canyon on August 21, 1976 (Table 2).

Aquatic bottom invertebrates were collected by three Suber samples taken at each sampling stations. Invertebrates were identified and enumerated for the three combined samples to determine the percentage relative numerical abundance of desirable food organisms at each station (Table 4).

Fish densities were estimated, for each station by electrofishing 200 foot stream sections with a Smith-Root type (battery) Electrofisher. All fish observed were counted and mean and range of total lengths were determined for a representative sample netted at each station (Table 3). The total length frequency distribution

of 280 rainbow trout measured was tabulated for each station and for the total of June and September surveys (Table 4). In addition, weights were determined for fish at Stations 3, 5, and 7 and total lengths measured for each station (Appendix B).

Riparian condition transects were made at Stations 2, 3, 4, 6, and 7 using the U. S. Forest Service's "Riparian Stand Analysis" method (Appendix C). Composition, density, vigor, stand, structure, and ground cover were rated either high, medium, or low for each condition transect (Table 3).

SAMPLING STATION NARRATIVES

A short commentary about the more important physical and biological characteristics observed at different sampling stations will follow as requested by the Gila National Forest.

Station 1 - Directly downstream from the junction of the North and South Forks.

On June 22, 1976 a 200 foot section of Mineral Creek was evaluated beginning 75 feet downstream from the junction of the forks. Both the North and South Forks were shallow streams considered to be only marginal trout habitat; however, small trout were observed in both forks.

Dominant plant species observed at Station 1 were White fir (Abies concolor) Douglas fir (Pseudotsuga taxifolia), limber pine (Pinus flexilis), and ferns.

Mean water depth and stream width were 5 inches and 4.5 feet, respectively. Three small pools (mean depth of 9 inches) resulted in a pool-riffle ratio of 5:95 (Table 1). Due to low stream flow (1.0 ft^3/sec) and only fair bank stability, stream improvement structures would probably not be functional or economically justified in this headwater section.

A total of 31 rainbow trout were counted in the 200 foot section electrofished. Of 21 fish measured, mean and maximum total lengths were 114 (4.5 inches) and 156 mm (6.2 inches), respectively (Table 3).

A ½ mile section of Mineral Creek between Stations 1 and 2 had 24 beaver dams. Most of these dams appeared to be abandoned as fresh beaver sign was noted at only 25% of the dams. As several dams would be typically be close together, it is likely that closely-spaced pools were used by the same beaver(s). The general lack of deciduous trees in this section resulted in conifers being used for dam construction and apparently food.

The majority of the beaver ponds were 15-20 in width at the dam and backed water upstream 30-40 feet. Most of the larger pools created were estimated to be 2-3 feet in depth at the dam (mean pool depths ca 1½ - 2 feet). Depths were

hard to estimate in the larger pools because water transparency was typically less than 2 feet. The greenish color of the water in the beaver ponds indicated phytoplankton production. In the larger pools, trout could be observed only when they were swimming within 2 feet of the surface.

All ponds had heavily silted bottoms. In some pools considerable cover in the form of beaver-felled trees was present. Many of the tree stumps appeared quite old, indicating a relatively long time had passed since they had been felled. The beavers in active ponds were having to go up the slopes to obtain suitable trees for food use. One particularly large beaver dam was approximately 10 feet tall from the top of the dam to the downstream base. This dam was 30-35 feet across and backed water upstream 60-70 feet. The maximum water depth was unknown, but may have been 5-6 feet at the dam.

The number of trout observed in pools generally ranged from 5 to 15, depending on pool size. Trout were larger in average size in these pools than measured at Stations 1 and 2. The largest trout observed were estimated to be 9-10 inches in length. Because of pool size, siltation, and downed trees, none of the beaver ponds were electrofished. It would be almost impossible to get a complete fish count in the larger pools. However, it would be desirable to attempt electrofishing several beaver ponds to get minimum population estimates and representative length measurements.

Station 2 - Third canyon (at Trail 203) downstream from the junction of the North and South Forks of Mineral Creek.

The canyon (Trail 203) used to mark the upstream boundary of Station 2 contained flowing water for at least ½ mile upstream from its mouth with Mineral Creek. Rainbow trout were Present in the lower 100 yards of this small tributary. Sampling of Mineral Creek began at the mouth of this tributary and continued downstream 200 feet on June 22nd. An additional 200 feet downstream was evaluated

for, physical and chemical parameters on September 4.

The riparian stand was similar to Station I in that Douglas fir and White fir were the dominant species. A riparian condition transect indicated the following ratings: composition, low; density, high; vigor, medium; and stand structure, low (Appendix C).

The physical habitat of the 400 foot section evaluated at Station 2 was almost identical to Station 1. Pool-riffle ratio and mean pool depth were slightly better, but still only marginal for trout habitat. On June 22 stream flow at Station 2 was 1.7 ft^3 /sec (compared to 1.0 ft^3/sec at Station 1) mainly by the added flow of the tributary at the upstream terminus of the station.

The somewhat improved physical habitat resulted in a much greater population density of 79 fish per 200 foot section electrofished. The mean and maximum lengths (119 (4.7 inches) 161 mm (6.3 inches) respectively) were also slightly greater (Table 3).

Station 3 - 500 yards downstream from the junction of the Sandy Point Trail (202) and Mineral Creek Trail (201).

This sampling station was evaluated on September 4, 1976. The dominant riparian species were Douglas fir and Arizona alder (Alnus oblongifolia). The riparian condition was rated as follows: density, high; vigor and composition, medium; and stand structure, low.

Pool-riffle ratio (5:95) and percent rubble (80%) at Station 3 was typical of that observed on upper Mineral Creek (except for the beaver dam section). Bank stability was generally good, but low bank height would limit possible sites for installation of stream improvement structures.

In the 200 foot section electrofished, 77 rainbow trout were counted. The mean length and weight of 34 trout (age land older) netted and measured were 132 mm (5.2 inches) and 30.6 grams (0.067 pounds), respectively. Several young

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of-year trout (mean length 25 mm) were collected on June 23, 1976.

Between Stations 3 and 4, Bear Canyon and Bear Wallow Canyon were checked for possible fish populations. Water was found in shallow pools about 200 yards up Bear Wallow Canyon, but no fish were observed. No surface water was present within the next 1/2 mile up the canyon or in the lower 3/4 mile section of Bear Canyon.

Station 4 - From the mouth of Bear Wallow Canyon downstream 400 feet.

The mouth of Bear Wallow Canyon marked the upstream boundary of the 200 foot sample made on June 23, 1976. An additional 200 foot section was evaluated immediately downstream from the June survey on September 4, 1976, but was not electrofished.

The riparian stand was dominated by Douglas Fir with box elder (Acer negundo), Arizona walnut (Juglans major), and sumac (Rhus sp.) as subdominants. The riparian condition transect scored density, vigor, and stand structure as high and composition as medium. The understory forbs and grasses were generally grazed short by cattle.

Station 4 had the greatest stream width (6.5 ft) and flow rate (1.8 ft^3/sec) observed during both the June and September surveys. The pool-riffle ratio (10:90) and mean pool depth (14 inches) limited the desirability of the existing habitat. However, the increased flow, good bank stability, and greater bank height improved the potential for constructing stream improvement structures downstream from the mouth of Bear Wallow Canyon.

Station 4 had the greatest number of fish per 200 foot sample electrofished (87) but mean length was still only 119 mm (4.7 inches). A large pool (4 ft in depth and 10 ft in diameter) just downstream from Station 4 was electrofished because of the numerous trout observed. The largest fish netted was 233 mm (9.2 inches). However, it was possible that all fish were not collected

because of an undercut bank and pool depth. Bruce Anderson had previously reported that a 14 inch rainbow trout was caught by an angler from this pool.

Approximately ½ mile downstream from Station 4, four old single-log stream improvement structures were evaluated. One structure had been undercut and the mean pool depth of two others was only 10 inches. The fourth structure was still functional and had created a pool 2 ft in depth and 12 ft in length.

Station 5 - One mile downstream from Station 4 where a steep cliff overhangs the trail.

This section (sampled September 23) of Mineral Creek is a popular camping site as indicated by old fire places and scattered trash. At Station 5 pool-riffle ratio (50:50) and stream gradient become unusually great for approximately 150 yards. Because of the numerous large pools and greater mean depth (24 inches), this section of Mineral Creek was considered excellent trout habitat and, therefore, the lower 200 feet of this high gradient section was selected as a sampling station.

A total of 80 rainbow trout were counted in the 200 ft section electro-fished at Station 5. The mean length and mean weight of the 46 fish (age 1 and older) measured were 134 mm (5.3 inches) and 24.6 grams (0.054 pounds), respectively. However, when the 17 young-of-year rainbow trout were not included, the mean length of 46 fish measured was 134 mm (5.3 inches). Although no trout >221 mm (8.7 inches) were collected or observed, it was possible that larger trout were present, but weren't collected because of the large size of some pools. Another possible reason for the absence of larger trout was sport fishing.

The physical habitat from the high gradient section of Station 5

downstream for approximately ½ mile was the best trout habitat observed during surveys of Mineral Creek. A natural barrier in the form of a 6 ft vertical waterfall marked the downstream terminus of this better habitat section.

Station 6 - Approximately ½ mile upstream from Log Canyon.

The 200 ft section that was sampled on June 23, 1976 included electro-fishing. An additional 200 ft section was monitered for physical habitat, chemical, and riparian conditions on September 5, 1976.

The dominant riparian species were Arizona alder, box elder, Arizona Walnut, ash (Fraxinus spp.), and Gambel oak (Quercus gambelii). Riparian composition, density, vigor, and stand structure were all rated high by the riparian condition transect. Bare ground and erosion pavement were noted on 20 of 100 hits. Therefore, ground cover index just barely rated a medium score.

Pool-riffle ratio for the 400 foot sample was 14:86. Bottom type and percent stream shading still rated high but decreased flow rate and mean pool depth (14 inches) reduced the desirability of the physical habitat. Generally poor bank stability and the lack of suitable bank height reduced the potential for stream improvement structures at Station 6.

Although the physical aspects at Station 6 were generally less desirable than noted at Station 5, the number of trout counted (69) in the 200 foot sample was comparable. As this station was electrofished during the June survey, no young-of-year trout were included in the count. The mean and maximum lengths of 134 mm (5.3 inches) and 233 mm. (9.2 inches), respectively, were also comparable to fish measurements at Station 5.

On August 21, 1976 a large shallow pool was observed in Mineral Creek that was created by the deposition of rubble and gravel originating in the Red Canyon watershed. The damming effect of these deposits created a 60-70

foot long pool (containing an estimated 20-30 fish) just upstream from the mouth of Red Canyon. From Red Canyon downstream several obvious changes occured in Mineral Creek and its floodplain. Grazing pressure appeared to be heavy and resulted in considerable bare soil in the riparian stand. Silt and mud deposits were noted to cover the gravel and rubble bottom where water current was insufficient to flush finer deposits. Also decreased bank stability and bank height further limited the possibility for adding stream improvement structures.

The stream bottom became wider and less shaded downstream. Several stretches would probably be intermittent during drought conditions. Fish population density became limited by physical habitat conditions. In general, the trout observed were less than 6 inches in length. However, one unusually good pool created out of bedrock near the Cooney Site held two trout which were estimated to be 10-12 inches in length.

Station 7 - 200 years upstream from end of Road 701.

This 200 foot sample was made on September 6, 1976 in a box canyon with steep cliffs. Arizona alder, Arizona walnut, and Willow (Salix sp.) were the dominant riparian species with bod elder and Arizona sycamore (Platanus wrightii) was subdominants. A riparian condition transect made just downstream from Station 7 rated composition, vigor, and stand structure as high and density as medium. Bare ground (and erosion pavement) and rock were recorded on 33 and 36 hits, respectively, out of 100 hits.

The 200 foot section was selected because its pool-riffle ratio (50:50) provided the best fish habitat in the immediate area. The stream bottom was mainly bedrock with sand and silt collecting in small indentations and pool areas in the bedrock. Pool areas were created by narrow chutes in the bedrock and circular depressions created where water flow stair-stepped over solid rock declines (2-6 ft) or variable gradient (up to 90%). These pools were

generally without cover other than a few boulders and probably get too warm for trout during periods of unusually low flow in the late spring and summer.

Although this area was apparently marginal habitat, a total of 36 trout were counted in the 200 foot sample. However, the mean length of the fish measured was only 97 mm (3.8 inches). During verbal communication with the two U. S. Forest Service employees clearing the trail on Mineral Creek, it was reported that this section of Mineral Creek goes dry during droughts. The preponderance of young-of-year fish and the absence of any trout >161 mm (6.3 inches) tended to confirm this report. Young-of-year rainbow trout were observed as far downstream in Mineral Creek as the pool at the ford just upstream from the corral on Road 701.

Table 1. Physical and Chemical Characteristics of Mineral Creek at Different Sampling Stations

Characteristic	Sampling Station									
	1[a]	2[a]	2[b]	3[b]	4[a]	4[b]	5[b]	6[a]	6[b]	7[b]
Military Time	1100	1600	1420	1000	1145	1500	1830	1545	1245	900
Elevation (feet)	7760	7520	7520	7200	6800	6800	6560	6320	6320	5560
Weather conditions	Sunny	Cloudy	Cloudy	Clear	Sunny	Cloudy	Cloudy	Clear	Rain	Clear
Percent Pool	5%	10%	5%	5%	5%	15%	50%	22%	6%	60%
Percent, Riffle	95%	90%	95%	95%	95%	85%	50%	88%	94%	40%
Number of Pools	3	4	12	2	2	14	3	7	2	1	8
Mean Pool Depth (inches)	9			13			24	14	13	14
Stream Bottom Type (%)										
Boulder	15%	10%	20%	10%	15%	10%	30%	2½%	5%	
Rubble	80%	85%	75%	80%	80%	80%	35%	90%	80%	5%
Gravel	5%	5%	5%	10%	5%	10%	25%	5%	10%	
Fines							5%	2½%	5%	30%
Bedrock							5%			65%
Sreamside vegetation										
Percent shaded	75%	65%	65%	65%	75%	60%	75%	95%	50%	40%
Bank Stability	Fair	Good	Good	Good	Fair	Good	Good	Poor	Poor	Excellent
										Bedrock
Mean Stream Width (ft)	4.5	5.0		5.5	6.5		6.0		7.0	7.0
Flowrate (C.F.S.)	1.0	1.7	1.1	1.3	1.9	1.8		1.4	1.7	
Temperature										
Air (F)	86	79	74	51	65	68	53	74	63	58
Water (F)	61.5	58	58	52	58	56	57	66	52	57
Dissolved Oxygen (ppm)	7.8	7.4	7.4	7.8	7.4	7.2	8	7	8	7.6
Carbon dioxide (ppm)	<0.5	<0.5	<2	<1	<0.5	<2	<1	<0.5	<1	<1
	7.8	7.8	8	7.6	7.8	7.7	7.7	7.8	7.8	7.7

[a] Information collected during the June 22-24, 1976 survey.

[b] Information collected during the September 4-6, 1976 survey.

Table 2. Selected water chemistry characteristics of Mineral Creek.

Characteristic	Location where water sample collected				
	Station 3[a]	Red Canyon[b]	Station 7[a]	Station 7[c]	Below Tomb[b]
Total Alkalinity (ppm)		55		90.6	100
Turbidity		N.T.U.		J.T.U.	N.T.U.
		1.0		22	1. 6
Conductance .Micro Moles)	87	140	223	245	240
Total dissolved solids (ppm)	68	-	172	-	-
pH	7.8	7.5	7.9	8.4	8.0
Sulfate (ppm)	-	-	-	0.0	-
Nitrate (ppm)	-	0.20	-		0.00
Phosphate (ppm)	-	0.22	-	-	0.17
Copper (ppm)	-	-	-	<0.05	-
Iron (ppm)	-	-	-	0.00	-
Zinc (ppm)	-	-	-	0.00	-
Nickel (ppm)	-	-	-	0.00	-
Magnesium (ppm)	-	-	-	Trace	-
Hardness (Ca,ppm)	-	30	-		80

[a] Water samples collected during September 4-6, 1976 survey.

[b] Water samples collected by Dr. John Rinne (Rocky Mountain Forest and Range Experiment Station, Tempe on August 21, 1976.

[c] Water sample collected and analyzed by Rhea Soloman (U.S. Forest Service, Silver City) about 400 years downstream from station 7 on July 30, 1975. Turbidity in Jackson Turbidity Units.

Table 3. Summary of fish population and riparian transect findings for Stations 1 - 7.

Criteria	Station 1[a]	2[a]	3[b]	4[a]	5[b]	6[a]	7[b]
Number of fish /200 ft electrofished	31	79	77	87	80	69	36
Range in total lengths in mm.	86-156	61-161	49-196	86-203	59-221	89-223	64-161
Mean total length in mm	114.2	119.0	109.6	119.0	114.7	133.9	96.9
(inches)	(4.5)	(4.7)	(4.3)	(4.7)	(4.5)	(5.3)	(3.8)
Number *of fish* measured	21	35	51	54	63	32	24
Riparian Condition							
Composition	-	LOW[b]	Medium[b]	Medium[b]	-	High[b]	High[b]
Density	-	High	High	High	-	High	High
Vigor	-	Medium	Medium	High	-	High	High
Stand Structure	-	Low	Low	High	-	High	Medium
Soil	-	Medium	High	High	-	Medium	Low

Table 4. Total number of aquatic invertebrates collected in three Surber samples at Stations 1-7

Invertebrate taxa	Number of organisms at each station 1[a]	2[a]	2[b]	3[b]	4[a]	4[b]	5[b]	6[a]	7[b]
Ephemeroptera	19	6	67	37	16	29	16	35	8
Plecoptera	2	1	6	13	8	18	6	5	0
Trichoptera	2	13	2	17	27	19	2	20	6
Coleoptera (adult)	-	1	9	-	-	11	10	6	1
Coleoptera (larva)		1	10	19	-	15	15	6	2
Odonata		-	-	1	-	1	2	1	1
Diptera	1	1	-	-	-	2	4	-	2
Unknown	1	2	3	8	3	-	-	8	5
Total Number	25	25	97	95	54	95	55	81	25
Percentage of total Biomass in desirable groups[c]	94%	97%	90%	80%	99%	70%	50%	65%	50%

[a] Information collected during the June 22-24, 1976 survey.

[b] Information collected during the September 4-6, 1976 survey.

[c] Percentage of total biomass of aquatic invertebrates that were mayflies (Ephemeroptera) stoneflies (Plecoptera), and caddis flies(Trichoptera).

Table 4. Total length frequency distribution of 280 rainbow trout measured during stream surveys of Mineral Creek.

Length class (mm)	Station							Sum of Stations	
	1[a]	2[a]	3[b]	4[a]	5[b]	6[a]	7[b]	1,2,4,6	3,5
40 - 49			1						1
50 - 59			1		2				3
60 - 69		1	9		6		4	1	15
70 - 79		5	6		8		7	5	14
80 - 89	3	1		3	1	1	5	8	1
90 - 99	8	2	2	17	1	2	1	29	3
100 -109	1	1	4	7	10	8		17	14
110 -119		3	8	5	1	2		10	9
120 -129	1	6	4	4	10	6	1	17	14
130 -139	3	6	4	6	9	1	1	16	13
140 -149	2	7	5	4	6	2		15	11
150 -159	3	2	3	2	2	4	3	11	5
160 -169		1	1	3	3	2	2	6	4
170 -179			1	1	1			1	2
Minimum catchable size									
180 -189			1	1		1		2	1
190 -199			1		1	2		2	2
200 -209				1	1			1	1
210 -219									
220 -229					1				1
230 -239						1		1	
Mean length[c] mm	114	119	132	119	134	134	97	122	133[c]
(inches)	(4.5)	(4.7)	(5.2)	(4.7)	(5.3)	(5.3)	(3.8)	(4.8)	(5.3)
Number[c] of fish measured	21	35	34	54	46	32	24	142	80

[a] Fish collected during the June 22-24, 1976 survey.

[b] Fish collected during the September 4-6, 1976 survey.

[c] Young-of-Year fish not included in mean lengths or number of fish measured

Summary

Physical Habitat Survey

Mineral Creek has a relatively narrow watershed (westerly-flowing) (Figure 1) which lies just north of the Whitewater Creek drainage and the headwater portions of the Willow Creek drainage. The creek was evaluated from the junction of the North and South Forks (Station 1) downstream about 10½ miles to the box canyon upstream from Road 701 (Station 7).

Mineral Creek is an aesthetically pleasing stream which has its headwaters in the spruce-fir community at 7500-9000 feet and then drops rapidly into the pinyon-juniper community before becoming intermittent. Riparian species are dominated by coniferous species (Douglas fir, White fir, and Limber pine) at Stations 1 and 2. Douglas fir remains the dominant species at Stations 3 and 4 with deciduous species like Arizona alder, box elder, and Arizona walnut as subdominants. The previously mentioned deciduous species dominate the riparian stand at Stations 6 and 7 with ash, willow, Gambel oak, and Arizona sycamore as subdominants.

Pool-riffle ratio is generally low (≤10:90) except for the following areas: ½ mile stretch with beaver dams between Station 1 and 2; Station 5 downstream ½ mile; and the marginal stretch of stream with bedrock pools near Station 7. Except for Station 5 and in beaver ponds, mean pool depths were 14 inches. With the exception of bedrock bottom at Station 7, stream bottom type was mainly rubble (usually 75-90%) with boulder and gravel making up the remainder of the stream bottom.

Streamside vegetation and canyon walls shade 60-75% of Mineral Creek at Stations 1-6. Bank stability is fair to good upstream from Station 6, but less desirable downstream. However, placement of stream improvement structures

would be limited by low bank height upstream from Station 4.

Stream width increases from 4.5 feet at Station 1 to 7.0 feet at Station 6. Flow rate was uniformly low (1-2 $feet^3$ /sec) at all stations during both June and September surveys. It seems likely that the series of beaver dams downstream from Station 1 provide for a slow continual release of water during low flow periods. In this sense, the storage of water in the beaver ponds probably serves to stabilize flow rates and should be considered beneficial to trout survival during drought conditions. Water level in several beaver ponds was lower than dam height during the June survey, but most ponds were full to the top of dams in September.

Water Quality Survey

Watershed conditions appear to be relatively good upstream from Station 6. Beginning at Station 6, grazing becomes increasingly more apparent as you proceed downstream. From Red Canyon downstream the presence of silt and fines in the stream bottom becomes a negative factor. Watershed conditions in Red Canyon may be the primary factor contributing to increased fines downstream as it appears to deposit considerable gravel and rubble ia the Mineral Creek floodplain. Several old mines and private land holdings may also be confounding factors downstream from Red Canyon.

Dissolved oxygen and carbon dioxide concentrations and pH were well within recommended range at all stations. Water temperatures generally ranged from 52-61.5 F at all stations. The water temperature reading of 66 F at Station 6 on June 23 was taken at 3:45 P.M. and was probably near the daily maximum.

Turbidity, alkalinity, and heavy metal measurements of a water sample collected near Station 7 were well within acceptable ranges. Conductance of three different water samples taken near Station 7 ranged from 223 to 245 Mico Moles. When total dissolved solids was determined by evaporation at 50 C,

a reading of 172 ppm was obtained. Total dissolved solids of a water sample collected at Station 3 on the September survey had a concentration of 56 ppm. This is a relatively great increase in T.D.S. from Station 3 to 7. However, I suspect comparable measurements taken from Stations 1 and 6 would show less of a percent increase in T.D.S. Mineral Creek downstream from the mouth of Red Canyon is presently a marginal habitat for trout and should be considered separately when discussing the desirability of the stream as a possible restoration site for Gila trout.

Relatively low flow rates (1-2 C.F.S.) observed during both June and September survey were the major negative physical characteristic of Mineral Creek. Verbal communication with Forest Service personnel indicated 1976 was a low water year for the Mineral Creek watershed. This was apparent in the June survey made before summer rains began. Flow was only 1.0 C.F.S. at Station 1 in June compared to 1.7 C.F.S. at Station 2. Increased flow was attributed to flow from the samll canyon at Station 2 and beaver pond leakage. The relatively low flow observed was obviously a function of the small watershed area (ca. 40 square miles) and the timing of stream surveys. Although this low flow rate is not necessarily a particularly negative factor, it does point out the likelihood of fish losses during drought condition. The addition of stream improvement structure to create deeper pools would alleviate the potential for heavy fish losses in some areas. Another possibility would be the construction of one or more check dams in the headwater portions of Mineral Creek to allow for water release during droughts. The series of beaver dams between Stations land 2 provide a similar function at the present time.

Discussion and Recommendations

When Mineral Creek was rated using the Forest Service's "Habitat Evaluation Technique", Stations 1-6 were scored high (7-10) in all major habitat categories except pool-riffle ratio (which scored 0 at most stations). Therefore, Mineral Creek appears to be particularly well-suited for addition of stream improvement structures. Improvement structures would be most desirable from Station 4 (Bear Wallow Canyon) downstream l½ to 2 miles. In the vicinity of Station 4, pool-riffle ratio could be increased from 10:90 to 25:75 by constructing about two improvement structures per 100 feet of stream. It would seem desirable to do a small scale comparative study of single log, double log, and trash catcher type structures before beginning any major stream improvement work. It should be noted that the stream bottom was 10-30% boulder at Stations 4 and 5. The primarily boulder-rubble bottom type in this portion of the stream might lend itself to the construction of the relatively cheaper trash catcher-type structures.

The desirability of increasing the quanity and quality of pool habitat in Mineral Creek is apparent in the length frequency distribution of rainbow trout collected during the two survey trips. For example, only 11 of 280 fish measured were >7.0 inches (178 mm) which is normally considered the minimum total lenght for catchable-sized trout (Table 4). The small size of rainbow trout was apparently caused by the relatively great population densities and limited pool habitat available.

It should be realized that the high population densities found in these collections represent mainly fish in age groups 2 and younger. Length frequency distriubtions and preliminary age and growth determinations indicated that mean total lengthes at time of annulus formation were 76, 135, 179,

and 214 mm (3.0, 5.3, 7.0, and 8.4 inches) for ages 1-4, respectively.

The relatively few fish 7 inches collected indicate either (1) that a substantial reduction occurred in the trout population during the relatively dry winter and spring of 1974; or (2) that 7-9 inches is the maximum size rainbow trout can reach in the majority of the habitat found in Mineral Creek.

Although an angler report of a 14 inch trout was noted in the report, fish exceeding 9 inches were apparently restricted to larger pools which were difficult to adequately sample with electrofishing gear. Areas with trout of greater lengths would be restricted to the 150 meter high gradient section at Station 5 and the larger beaver dam-created pools between Stations 1 and 2. Three large trout (>9") were visually observed in these areas.

Based on the findings of these surveys, Mineral Creek would presently support only a marginal trout fishery. It is possible that 1-2 additional years of average or above average water conditions would result in larger numbers of catchable-sized trout in Mineral Creek. However, the generally poor pool-riffle ratio and small size and depth of most existing pools would make the negative effects of a potential drought relatively great. Substantial reductions in trout numbers from, existing densities would probably occur during severe drought conditions in areas without suitable refuge areas in form of pools of sufficient depth. The potential effects of drought would be reduced by constructing stream improvement structures in from leaky beaver dams or a check dam constructed in the headwater potion of the stream would help alleviate the effects of low or no flow conditions.

The mean number of rainbow trout per 200 foot samples electrofished was 70.5 for Stations 1-06. If this estimate of population density was expanded to number per linear mile of stream, a estimate of 1861 trout per mile would result. Assuming a mean weight of 25 grams per fish, Mineral Creek had a carrying capacity of approximately 100 pounds of trout per stream mile during

the summer of 1976.

When the above-mentioned population density was multiplied times 8.5 miles (Mineral Creek from the Forks to the mouth of Red Canyon), the total estimated rainbow trout population would be approximately 15,800 fish. Additional rainbow trout occur in the 2 mile section below the mouth of Red Canyon, but this habitat is marginal for trout and contains sections without fish.

In summary, Mineral Creek would serve as a suitable restoration site for the introduction of Gila trout from Spruce Creek. Construction of stream improvement structures would enhance the quality of trout habitat and should lessen the impact of extended drought conditions. Grazing control in the lower portions of the stream would be desirable. The possibility of constructing one or more small check dams in the headwater portions of Mineral Creek for gradual water release during droughts should be evaluated. Additional studies on stream flow and water quality, especially total dissolved solids, would be worthwhile considerations.

APPENDIX A. LOCATION OF SAMPLING STATIONS.

Station 1 - Directly downstream from the junction of the North and South Forks of Mineral Creek. (T.10 S., R.18 W., Section 35)

Station 2 - Third Canyon (at Trail 203) downstream from the junction of the North and South Forks. T.10 S., R.18 W., Section 35 (ca. 1 mile from Station 1).

Station 3 - 500 yards downstream from the junction of the Sandy Point Trail (202) and Mineral Creek Trail (201). T. 10. S. , R. 18 W. , Section 33 (ca. 2½ miles from Station 1).

Station 4 - From the mouth of Bear Wallow Canyon downstream 400 feet. T.10, S., R.18 W., Section 31 (ca. 4 3/4 miles from Station 1).

Station 5 - One mile from Station 4 where a steep cliff overhangs the trail. T.10.S., R.19 W., Section 36 (ca. 5 3/4 miles from Station 1).

Station 6 Approximately 1/2 mile upstream from Log Canyon T.10.S., R.19 W., Section 26 (ca. 7 ¼ miles from Station 1).

Station 7 200 yeard upstream from end of Road 701. T.10.S., R.19 W., Section 20 (ca. 10½ miles from Station 1).

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